



**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY**  
WASHINGTON, D.C. 20460

OFFICE OF  
PREVENTION, PESTICIDES  
AND TOXIC SUBSTANCES

**Note to Reader**  
**January 8, 1998**

**Background:** As part of its effort to involve the public in the implementation of the Food Quality Protection Act of 1996 (FQPA), which is designed to ensure that the United States continues to have the safest and most abundant food supply. EPA is undertaking an effort to open public dockets on the organophosphate pesticides. These dockets will make available to all interested parties documents that were developed as part of the U.S. Environmental Protection Agency's process for making reregistration eligibility decisions and tolerance reassessments consistent with FQPA. The dockets include preliminary health assessments and, where available, ecological risk assessments conducted by EPA, rebuttals or corrections to the risk assessments submitted by chemical registrants, and the Agency's response to the registrants' submissions.

The analyses contained in this docket are preliminary in nature and represent the information available to EPA at the time they were prepared. Additional information may have been submitted to EPA which has not yet been incorporated into these analyses, and registrants or others may be developing relevant information. It's common and appropriate that new information and analyses will be used to revise and refine the evaluations contained in these dockets to make them more comprehensive and realistic. The Agency cautions against premature conclusions based on these preliminary assessments and against any use of information contained in these documents out of their full context. Throughout this process, If unacceptable risks are identified, EPA will act to reduce or eliminate the risks.

There is a 60 day comment period in which the public and all interested parties are invited to submit comments on the information in this docket. Comments should directly relate to this organophosphate and to the information and issues available in the information docket. Once the comment period closes, EPA will review all comments and revise the risk assessments, as necessary.

These preliminary risk assessments represent an early stage in the process by which EPA is evaluating the regulatory requirements applicable to existing pesticides. Through this opportunity for notice and comment, the Agency hopes to advance the openness and scientific soundness underpinning its decisions. This process is designed to assure that America continues to enjoy the safest and most abundant food supply. Through implementation of EPA's tolerance reassessment program under the Food Quality Protection Act, the food supply will become even safer. Leading health experts recommend that all people eat a wide variety of foods, including at least five servings of fruits and vegetables a day.

**Note:** This sheet is provided to help the reader understand how refined and developed the pesticide file is as of the date prepared, what if any changes have occurred recently, and what new information, if any, is expected to be included in the analysis before decisions are made. **It is not meant to be a summary of all current information regarding the chemical.** Rather, the sheet provides some context to better understand the substantive material in the docket ( RED chapters, registrant rebuttals, Agency responses to rebuttals, etc.) for this pesticide.

Further, in some cases, differences may be noted between the RED chapters and the Agency's comprehensive reports on the hazard identification information and safety factors for all organophosphates. In these cases, information in the comprehensive reports is the most current and will, barring the submission of more data that the Agency finds useful, be used in the risk assessments.

A handwritten signature in black ink, appearing to read 'J. Housenger', is written over the typed name and title.

Jack E. Housenger, Acting Director  
Special Review and Reregistration Division

**MEMORANDUM**

SUBJECT: Water assessment for disulfoton RED including drinking water assessment

TO: Walter Waldrop  
Special Review and Reregistration Division (7508W)

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DATE: December 11, 1997

**Summary and Conclusions**

This memorandum presents an assessment of the potential to contaminate ground water and surface water from labeled uses of disulfoton. This assessment includes Tier I and II estimates of environmental concentrations (EECs) in surface water for disulfoton as applied to barley, cotton, potatoes, tobacco, and wheat, using several label application rates and methods. Surface water monitoring data available in STORET are also considered. The potential for disulfoton residues in ground water are assessed using the EFED ground water concentration screening model (SCI-GROW) and the monitoring data available in EFED's Pesticides in Ground Water Data Base (PGWDB) and EPA's STORET. The purpose of this analysis is to estimate environmental concentrations of disulfoton in surface water bodies and ground water for use in the human health and ecological risk assessment as part of the registration process. Environmental fate data base is incomplete. Limited data indicates that the degradates are much more persistent and mobile than parent disulfoton. The degradates, often as toxic as the parent compound, are not considered in this assessment due to lack of environmental fate data.

The GENEEC (Version 1.2; 5/13/95) model was used to generate Tier I EECs for disulfoton used on barley, cotton, potatoes, tobacco, and spring wheat. The maximum peak, 4-day average, 21-

day, and 56-day average concentrations (EECs) were estimated using various combinations of application rates, numbers of applications, and application intervals (Table 1). GENEEC is a screening model used in Tier I (generic high run-off site) to estimate pesticide concentrations found in surface water up to 56 days. Thus, it provides an upper-bound concentration value which might be found in ecologically sensitive areas because of pesticide use. GENEEC is a single run-off event model, but can account for spray drift from multiple applications. GENEEC represents a 10-hectare field immediately adjacent to a 1-hectare pond that is 2-meters deep with no outlet. The pond receives a pesticide load from spray drift for each application plus what runs off in one rainfall event. The run-off event transports a maximum of 10% of the pesticide remaining in the top 2.5-cm of soil at the time the run-off event is assumed to occur into the pond. This amount can be reduced through soil sorption. The amount of pesticide remaining on the field in the surface 2.5 cm at the time of the run-off event occurs depends upon the application rate, number of applications, interval between application, incorporation depth, and degradation rate in the soil. Spray drift is determined by method of pesticide application (5% for aerial spray; 1% for ground spray). GENEEC and PRZM simulations were both made with the typical and maximum application rates, maximum number of yearly applications, and the shortest recommended application interval.

The Tier II EEC assessment uses a single site, or multiple single sites, which represents a high-end exposure scenario from pesticide use on a particular crop or non-crop use site. The EECs for disulfoton were generated for multiple crop scenarios using PRZM3 (Carsel, 1997) which simulates the erosion and run-off from an agricultural field and EXAMS 2.97.5 (Burns, 1997) which simulates the fate in a surface water body. PRZM3 and EXAMS estimates for a single site, over multiple years, EECs for a 1 ha surface area, 2 m deep pond draining an adjacent 10 ha barley, cotton, potato, tobacco, or spring wheat field. Each scenario, or site, was simulated for 27 to 40 (depending on data availability) years. EFED estimated 1 in 10 year maximum peak, 4-day average, 21-day average, 60-day average, 90-day, annual average concentrations. Disulfoton (Di-Syston) formulations were based upon registered uses on the specific crops. The application rates, numbers, and intervals are listed in Table 2 and environmental fate inputs are listed in Table 4. Spray drift is determined by method of pesticide application (5% for aerial spray; 1% for ground spray). The Tier II PRZM/EXAMS EECs for disulfoton are listed in a Table 2.

The PRZM/EXAMS EECs are generated for high exposure agricultural scenarios and represent one in ten year EECs in a stagnant pond with no outlet that receives pesticide loading from an adjacent 100% cropped, 100% treated field. As such, the computer generated EECs represent conservative screening levels for ponds, lakes, and flowing water and should only be used for screening purposes. The EECs have been calculated so that in any given year, there is a 10% probability that the maximum average concentration of that duration in that year will equal or exceed the EEC at the site. Tier II upper tenth percentile EECs are presented in Table 2.

The disulfoton scenarios are representative of high run-off sites for barley in the Southern Piedmont of Virginia (MLRA 136), cotton in the Southern Mississippi Valley Silty Uplands of Mississippi (MLRA 134), potatoes in the New England and Eastern New York Upland of Maine

(MLRA 144A), tobacco in Southern Coastal Plain of North Carolina (MLRA 133A), and spring wheat in the Rolling Till Prairie of South Dakota (MLRA 102A). The scenarios chosen are professional best judgement sites expected to produce run-off greater than would be expected at 90% of the sites where the appropriate crop is grown.

<b>Table 1. Surface water concentrations estimates from GENEEC (Version 1.2) for disulfoton.</b>							
Crop	Application Rate/Number/ Interval (lb.ai./ac/#/days)	Drift (%)	Depth Inc.	Peak	4-day	21-day	56-day
Barley	1.005/2/21	0	0.0	28.0	27.5	25.1	21.6
Barley	0.826/2/21	5	0.0	23.0	22.6	20.6	17.8
Cotton	1.009/3/21	0	2.5	13.0	12.7	11.6	10.0
Cotton	3.270/3/21	0	2.5	42.0	41.2	37.6	32.5
Potatoes	4.005/2/14	0	2.5	48.7	47.8	43.7	37.7
Potatoes	9.390/2/14	0	2.5	114.2	112.2	102.4	88.5
Potatoes	4.000/2/14	0	0.0	121.6	119.5	109.0	94.2
Potatoes	9.390/2/14	0	0.0	285.4	280.4	255.9	221.2
Tobacco	8.170/1/0	0	2.5	57.6	56.6	51.6	44.6
Tobacco	4.005/1/0	0	2.5	28.2	27.7	25.3	21.9
Tobacco	16.33/1/0	0	2.5	115.1	113.1	103.2	89.2
Spr. Wheat	1.005/1/0	0	0.0	17.7	17.4	15.9	13.7
Spr. Wheat	0.637/1/0	0	0.0	11.2	11.0	10.1	8.7
Spr. Wheat	0.637/1/0	5	0.0	12.4	12.2	11.1	9.6

The SCI-GROW (Screening Concentration in Ground Water) screening model developed in EFED (Barrett, 1997) was used to estimate potential ground water concentrations for disulfoton parent under hydrologically vulnerable conditions. The maximum disulfoton ground water concentration predicted by the SCI-GROW using the maximum rate 9.39 lb. a.i./ac and 2 applications was 0.83 µg/L.

**Table 2. Tier II Upper Tenth Percentile EECs for Disulfoton Used on barley, cotton, potatoes, tobacco, and spring wheat for several application rates and management scenarios estimated using PRZM3/EXAMs.**

Crop	Disulfoton Application	Concentration (µg/L) (1-in-10 annual yearly maximum value)					
	Rate/Number/Interval/Incorp. Depth						
	lb.ai../ac/ #/ days/ inches	Peak	96-Hour Avg.	21-Day Avg.	60-Day Avg.	90-Day Avg.	Annual Avg.
Barley	1.00/2/21/0	17.92	17.48	15.85	13.95	12.59	7.12
Barley	0.83/2/21/0	18.02	17.62	16.50	14.75	13.56	7.75
Cotton	1.01/3/21/2.5	16.75	16.35	14.98	13.39	12.63	7.47
Cotton	3.27/3/21/2.5	54.24	52.97	48.54	43.35	40.91	24.20
Potatoes	4.01/2/14/2.5	22.08	21.62	20.21	17.78	16.13	7.98
Potatoes	9.39/2/14/0	117.00	114.50	106.50	93.54	85.92	43.24
Potatoes	4.00/2/14/0	49.76	48.69	45.44	39.84	36.59	18.42
Potatoes	9.39/2/14/2.5	51.78	50.69	47.39	41.69	37.83	18.71
Tobacco	8.17/1/0/2.5	98.19	95.71	87.30	75.11	68.75	40.33
Tobacco	4.00/1/0/2.5	20.85	20.27	18.24	15.70	14.38	8.17
Tobacco	16.33/1/0/2.5	85.02	82.66	74.36	64.00	58.62	33.29
Spr. Wheat	1.00/1/0/0	7.90	7.72	7.08	6.03	5.51	3.08
Spr. Wheat	0.64/1/0/0	10.20	9.96	9.44	8.32	7.71	4.77

The fate of disulfoton in surface water and ground water and the likely concentrations cannot be modeled with a high degree of certainty since no data are available for the aerobic and anaerobic aquatic degradation rates, and anaerobic soil metabolism. The large degree of latitude available in the disulfoton labels also allows for a wide range of possible application rates, total amounts, application methods, and intervals between applications. However, considering the relatively rapid rate of microbial degradation in the soil (<20 day aerobic soil metabolism half-life) and direct aquatic photolysis in (surface water, the disulfoton parent may degrade fairly rapidly. However, peak concentrations appear capable of being quite high, when high application rates used.

Ground water and surface water monitoring data tends to confirm fairly rapid degradation, but

potentially high peak values. The majority of samples had low levels ( $<16\text{ }\mu\text{g/L}$ ) of disulfoton residues. However, there were indications of some high concentrations (may be a reflection of how the data were reported) as the disulfoton concentrations in the monitoring were not always known. This is because the detection limit was not adequate (extremely high) or specified, and/or the limit of quantification was not stated or extremely high. Disulfoton concentrations were simply given as less than a value. Therefore, considerable uncertainty exists with respect to the monitoring data (especially the STORET data). Although, no assessment can be made for degradates due to lack of data, limited data suggests that the degradates are more persistent ( $>200$  days) than disulfoton, suggesting their presence in water for a longer period of time than the parent. The degradates also appear to be more mobile than the parent compound.

### **Pesticide Use and Application Rates**

Disulfoton is an insecticide used on a variety of food and non-food commodities. Disulfoton is formulated as 15% granules, 8% emulsifiable systemic, 95% cotton seed treatment, systemic granules (1, 2, 5, 10%), and 68% concentrate for formulating garden products.

Applications are generally soil applied: in-furrow, broadcast, or row treatment followed by 2-3 inch soil incorporation. It can also be applied as a foliar treatment and in irrigation water. Cotton seeds can also be directly treated and planted. Disulfoton can be applied in multiple applications, typically up to three, at intervals from 7 to 21 days depending upon the crop. The application rates, number of applications, and interval between applications used are summarized in Tables 1 and 2.

The application rates selected (Tables 1 and 2) were based upon information submitted by the registrant, analysis conducted by BEAD, and the disulfoton (Di-Syston) labels. Four factors went into selecting the application rate: 1) the range of ounces or pounds a.i.; 2) the area or length of row per acre (which is influenced by row spacing); 3) the number of applications; and 4) the application interval. The maximum rate (ounces or pounds a.i. per crop simulated) and the shortest application interval were selected. The shorter the distance between the crop rows the greater the application rate on an area basis. Two row spacing values were generally selected; one based on a near-the-maximum number of rows indicated by the label, and second based on the row spacing given in the label example (e.g., tobacco, page 8 of 14; 20 to 40 oz. per 1000 feet of row (for "any row spacing") or 13.3 to 26.7 lb. per acre or with a 48 inch row spacing). The label indicated that "any row spacing" could be as narrow as 6 inches. The narrowest row spacing used in this assessment was 12 inches. Thus a crop like tobacco had a range of application rates of 4.005 to 16.33 lb. a.i. per acre.

### **Modeling Scenarios**

Surface Water: The sites selected are currently used by EFED to represent a reasonable "at risk" soil for the region or regions being considered. The scenarios selected represent high-end exposure sites. The sites are selected so that they generate exposures larger than for most sites

(about 90 percent) used for growing the selected crops. An “at risk” soil is one that has a high potential for run-off and soil erosion. Thus, these scenarios are intended to produce conservative estimates of potential disulfoton concentrations in surface water. The crop, MLRA, state and site conditions for the scenarios considered are given in Table 3.

Ground Water: The SCI-GROW (Screening Concentration in Ground Water) screening model developed in EFED (Barrett, 1997) was used to estimate potential ground water concentrations for disulfoton parent under hydrologically vulnerable conditions.

<b>Table 3. Crop, location, soil and hydrologic group for each modeling scenario.</b>						
<b>Crop</b>	<b>MLRA<sup>1</sup></b>	<b>State</b>	<b>Soil Series</b>	<b>Soil Texture</b>	<b>Hydrologic Group</b>	<b>Period (Years)</b>
Barley	136	VA	Gatton	sandy clay loam	C	27
Cotton	134	MS	Loring	silt loam	C	36
Potatoes	133A	ME	Emporia	loamy sand	C	36
Tobacco	144A	NC	Loring	silt loam	C	36
Spr.Wheat	102A	SD	Peever	clay loam	C	40

<sup>1</sup>MLRA is major land resource area (USDA, 1981).

## **Environment Fate and Chemistry**

The environmental fate and chemistry data base for disulfoton is incomplete for the parent compound (Table 4). Fate data are not available for the degradation products. The major routes of dissipation are microbial degradation in an aerobic soil and aqueous photolysis and soil photolysis. Data are unavailable for anaerobic soil conditions and the aquatic environment. Disulfoton is stable to hydrolysis at the three pH values tested. The overall results of these mechanisms of dissipation appear to indicate that disulfoton has low to moderate persistence in the environment. Limited data suggests that the degradates are much more persistent.

Hydrolysis: The reported hydrolysis half-lives are 1174 days, 323 days, and 231 days in sterile aqueous buffered solutions at pH's 4, 7, and 9, respectively, for a 30 day study. Consequently, disulfoton is essentially stable to abiotic degradation.

Photolysis: Disulfoton degrades rapidly under aqueous photolysis. The half-life for aqueous photolysis (corrected for the dark control) is 3.87 days in a pH 5 buffered solution. The soil photolysis half-life was (corrected for the dark control) 2.4 days. For the purpose of modeling (in the water body), disulfoton the water photolysis rate was considered.



**Soil and Aquatic Metabolism:** The aerobic soil metabolism half-life of disulfoton was observed to be between <3 and 15.6 days . The aerobic soil metabolism half-life used in modeling is the upper 90% confidence bound on the mean of half-lives for three aerobic soils tested in the laboratory.

**Soil Water Partition Coefficient:** Adsorption/desorption studies of disulfoton indicated that it is slightly mobile to somewhat mobile depending on the soil. The Freundlich  $K_{ads}$  (organic carbon normalized Freundlich Kads) values were 6.9 (449), 4.8 (888), 4.5 (386), and 9.7 (483) for silt loam, sand, clay loam, and sandy loam textured soils, respectively. The average organic carbon normalized Freundlich Kads was estimated to be 551.5 ml/g soil carbon. The Koc model generally appears to be appropriate. Fate properties were generally selected to represent conservative conditions (e.g., maximum persistence and mobility). Chemical parameters used in the modeling of disulfoton are provided in Table 4.

<b>Table 4. Disulfoton fate properties and values used in (GENEEC, PRZM3/EXAMs) modeling.</b>		
Parameter	Value	Source
Molecular Weight	274.39	EFED One-liner 05/21/97
Water Solubility	15 mg/l @20	EFED One-liner 05/21/97
Henry's Law Coefficient	2.60 atm-m <sup>3</sup> /mol	EFED One-liner 05/21/97
Partition Coefficient (Koc)	551.5	EFED One-liner 05/21/97
Vapor Pressure	4.33E-06 mmHg	EFED One-liner 05/21/97
Hydrolysis Half-lives @ pH 4 pH 7 pH 9	1174 days 323 " 231 "	EFED One-liner 05/21/97
Aerobic Soil Half-life	19.39 days (0.03575/d)	Upper 90% confidence bound on the mean of half-lives for the three aerobic soils tested in the laboratory EFED One-liner 5/23/97; EFED "draft" RED
Water Photolysis	3.87 days (pH = 5) (0.179/d)	EFED One-liner 05/21/97
Aerobic Aquatic Half-life	no data	

## Modeling Procedure

GENEEC was run for a number of crops and pesticide application rates, numbers, intervals, and methods (Tables 1) and fate properties are summarized in Table 4.

The PRZM3 simulations were run for a period of 36 years on cotton, potatoes, and tobacco, beginning on January 1, 1948 and ending on December 31, 1983. Barley was run for 27 years (1956-1983) and spring wheat was run for 40 years (1944-1983). Scenario information is summarized in Table 3. The EXAMS loading (P2E-C1) files, a PRZM3 output, were pre-processed using the EXAMSBAT post-processor. EXAMS was run for the 27-40 years using Mode 3 (defines environmental and chemical pulse time steps). For each year simulated, the annual maximum peak, 96-hour, 21-day, 60-day, 90-day values, and the annual means were extracted from the EXAMS output file REPORT.XMS with the TABLE20 post-processor. The 10 year return EECs (or 10% yearly exceedance EECs) listed in Table 2 were calculated by linear interpolation between the third and fourth largest values by the program TABLE20. Cumulative frequency plots for each scenario are provided in Appendix I.

## **Modeling Results**

The Tier I upper-bound estimates of disulfoton concentrations in surface water using the GENEEC screening model results in minimum peak concentration of 11.2 µg/L for spring wheat in South Dakota and a maximum of 285.4 µg/L for potatoes in Maine. The minimum and maximum 56-day concentrations were 8.7 and 221.2 µg/L for wheat and potatoes, respectively.

In the Tier II assessment, the overall upper 90% confidence bound on the estimated multiple year mean concentrations of disulfoton in a farm pond over multiple years simulated ranged from 3.08 µg/L for a single maximum application (@1.00 lb. ai. ac) to spring wheat in South Dakota to 43.24 µg/L for potatoes in Maine with the two applications at the maximum application rate (@9.39 lb. ai./ac). These upper 90% confidence bounds are the best values to use in cancer risk assessments as they are the best estimates of lifetime mean concentrations. Maximum, or peak, estimated concentrations of 117.0 µg/L occurred for two 9.39 lb. ai/ac applications of disulfoton to potatoes. For the other scenarios, the maximum concentrations ranged from 7.72 to 98.19 µg/L. The Tier II modeling results from PRZM/EXAMs fall within the range of concentrations for surface water reported in the STORET database (0.0 to 100 µg/L). Because in STORET many samples were listed as “actual value is known to less than given value”, the maximum concentration of samples was not always known (see STORET discussion). The modeling results therefore cannot be confirmed by the monitoring data.

The GENEEC and PRZM/EXAMs estimated disulfoton residue concentrations in surface water appear to be strongly related to application rate, number of applications, application interval, and method of application.

The maximum disulfoton ground water concentration predicted by the SCI-GROW model (using the maximum rate 9.39 lb. a.i./ac and 2 applications) was 0.83 µg/L.

## **Disulfoton Monitoring Data**

The Pesticides in Ground Water Data Base (USEPA, 1992) summarizes the results of a number

of ground water monitoring studies conducted which included disulfoton (and disulfoton degradates D. sulfone and D. sulfoxide). Monitoring, with no detections (limits of detections ranged from 0.01 to 6.0 µg/L), have occurred in the follow states (number of wells): AL (10), CA (974), GA (76), HI (5), IN (161), ME (71), MS (120), MN (754), OK (1), OR (70), and TX (188). Disulfoton residues were detected in ground water in Virginia and Wisconsin. In Virginia, 6 of the 12 wells sampled had disulfoton detections ranging from 0.04 to 2.87 µg/L. In Wisconsin, 14 of 26 wells sampled had disulfoton residues ranging from 4.0 to 100.0 µg/L. One hundred twenty wells were analyzed in MS for degradates D. sulfone and D. sulfoxide and 188 wells were analyzed in TX for D. sulfone. Limits of detection were 3.80 and 1.90 µg/L for the sulfone and sulfoxide degrade, respectively, in MS. There were no degradates reported in these samples.

Several limitations for the monitoring data should be noted. These limitations include: the use of different limit of detections between studies, lack of information concerning disulfoton use around sampling sites, and lack of data concerning the hydrogeology of the study sites.

**STORET:** STORET is a computerized data base utility maintained by the Office of Water, EPA for the STOrage and RETrieval of chemical, physical, and biological data pertaining to the quality of waterways within and contiguous to the United States. Geographical, political, and descriptive information concerning sites where data have been collected, known as “stations” are the base to which data is attached. The data contained in STORET are collected, stored, and used by a variety of Federal, State, Interstate, and local government agencies. These data are generally made freely available to every citizen under the Freedom of Information Act (FOIA) or by direct access through a number of mechanisms.

All data in STORET are owned by the user-agencies (data owners). Incoming data to the system are edited for errors and inconsistencies, however, the owners of the data have the primary responsibility for its content. Because these studies are conducted by a variety of individuals for a number of reasons, the detection limits can be quite variable. Additionally, the STORET system imposes a structure and some minimum content requirements on incoming data, e.g., station identifier data, sample data temporal and spatial information, parametric data. Each agency which submits data to STORET manages its own data for its own purposes, and because their needs vary widely, the STORET data they maintain varies widely from one agency to the next. The actual use of disulfoton where the samples were collected is also not known. Therefore, it is often recommended that prior to use of STORET data for regulatory purposes the circumstances under which it was collected be ascertained.

A search of the EPA’s STORET (10/16/97) data base resulted in the identification of disulfoton residues at a number of locations. These results are summarized in Table 5. Some clarification about these data are necessary. First, the data base indicates that five analytical methods were used (39010, 39011, 81888, 82617, 82677 - STORET code numbers) with a variety of detection limits. These results also are reported with a number of “qualifiers” including: 1) actual value is known to less than value given, 2) analyzed but not detected, 3) estimated value - value not

accurate. For example, the maximum values given in Table 5 for the stream samples (for each method) are 16.00, 100.00, 1.00, and 0.21 µg/L. From this we know that disulfoton residues maybe present but at values less than the given value (maybe even 0.0). Thus, when a value of 100.00 µg/L is reported, we know the actual value is less than 100, but we don't know how much less.

The means are also not true means, since they are determined from the imprecise values as noted above. High detection limits may not preclude the possible presence of residues at levels less than the limit of detection. (e.g., if the detection limit is high disulfoton may be present although not identified, actual concentration were not always given, and many 0 values) but only given to provide an indication of the disulfoton detections observed. To put this in perspective, of the more than 15000 samples in the STORET data base, only one value was listed as less than 250 µg/L, approximately 800 were listed as less than 100 µg/L, and 3 were less than 50 µg/L. The remaining values were less than 16 µg/L with the majority of values being less than 1 (0 to 1). Minimum values reported tend to range between 0.02 and 0.1 µg/L.

STORET also reports disulfoton residues in ground water (Table 5). The range of disulfoton concentrations in ground water samples indicate values could be nearly as high as 100.00 and 250.00 µg/L. The exact concentration of these wells is not known, but it is unlikely that concentrations were actually this high (see above). The concentrations of disulfoton reported in ground water from monitoring studies (PGWDB and STORET) are sometimes greater than the maximum ground water concentrations predicted (0.83 µg/L) by the SCI-GROW model (using 9.39 lb. a.i./ac, 2 applications). But again, many of these "high" values are reported as "less than". The preponderance of values were less than 1.00 µg/L.

Table 5. Summary of disulfoton detections in STORET.				
Type of Water Body	# of Samples	Analytical Method	Concentration (µg/L)	
			mean	range
Stream	1940	39010/39011 <sup>1</sup>	0.41	0.00-16.00
“	253	81888 <sup>2</sup>	1.67	0.00-100.00
“	39	82617 <sup>3</sup>	0.88	0.05-1.00
:	5164	82677 <sup>4</sup>	0.03	0.00-0.21
Lakes	270	39011	0.011	0.01-0.10
“	2	81888	0.095	0.05-0.14
“	20	82617	1.00	1.00-1.00
“	52	82677	0.031	0.00-0.10
Springs	24	39011	0.018	0.01-0.10
“	15	81888	6.81	0.05-100.00
“	134	82677	0.03	0.008-0.060
Reservoirs	2	81888	0.15	0.10-0.20
Estuary	4	39011	0.01	0.01
“	1	82677	0.017	0.02
Canals	2	39011	0.50	0.5
“	215	81888	0.077	0.03-0.3
Wells	383	39010	1.52	1.00-100.00
“	951	39011	0.26	0.01-1.00
“	3108	81888	25.23	0.00-250.00
“	44	82617	0.74	0.03-1.00
“	2559	82677	0.025	0.00-0.14

<sup>1</sup>39010/39011 Flame Photometer Whole Water: disulfoton/disyston

<sup>2</sup>81888 Disulfoton Whole Water

<sup>3</sup> 82617 Disulfoton Total Recoverable whole water

<sup>4</sup> 82677 Disulfoton “filtered 0.07 µm” Total Recoverable whole water

## Limitations of this Modeling Analysis

There are several factors which limit the accuracy and precision of this modeling analysis including the selection of the high-end exposure scenarios, the quality of the data, the ability of the model to represent the real world, and the number of years that were modeled. There are additional limitations on the use of these numbers as an estimate of drinking water exposure. Degradation/metabolism products were also not considered due to lack of data.

The GENEEC is a screening model developed by EFED to be used in Tier I to estimate pesticide concentrations found in surface water for use in ecological risk assessments. It therefore is intended to provide an upper-bound concentration value which might be found in ecologically sensitive areas because of pesticide use. GENEEC is a single run-off event model, but can account for spray drift from multiple applications. GENEEC represents a 10-hectare field immediately adjacent to a 1-hectare pond that is 2-meters deep with no outlet. The pond receives spray drift from each application plus the one run-off event. The run-off event transports a maximum of 10% of the pesticide remaining in the top 2.5 cm of soil at the time of the assumed run-off event into the pond. This amount can be reduced through degradation in the field and the soil sorption. Spray drift is determined by method of pesticide application: 0-percent when applied as broadcast, in-furrow, 1% for ground spray, and 5% for aerial spray. Another major limitation in the current GENEEC simulations is that the aquatic (microbial) degradation pathway was not considered due to lack of data. Direct aquatic photolysis was however included.

Tier II scenarios are also ones that are likely to produce high concentrations in aquatic environments. The scenarios were intended to represent sites that actually exist and are likely to be treated with a pesticide. These sites should be extreme enough to provide a conservative estimates of the EEC, but not so extreme that the model cannot properly simulate the fate and transport processes at the site. Currently, sites are chosen by best professional judgement to represent sites which generally produce EECs larger than 90% of all sites used for that crop. The EECs in this analysis are accurate only to the extent that the sites represent the hypothetical high exposure sites. The most limiting aspect of the site selection is the use of the “standard pond” which has no outlet. It also should be noted that the standard pond scenario used here would be expected to generate higher EECs than most water bodies; although, some water bodies would likely have higher concentrations (e.g., a shallow water bodies near agriculture fields that receive direct run-off from the treated field).

The quality of the analysis is also directly related to the quality of the chemical and fate parameters available for disulfoton. Acceptable data are available, but rather limited. Data were not available for degradates and the aquatic aerobic metabolism rate was not known, but estimated. The measured aerobic soil metabolism data is limited, but has sufficient sample size to establish an upper 90% confidence bound on the mean of half-lives for the three aerobic soils tested in the laboratory (EFED One-liner, 1997). The use of the 90%-upper bound value may be sufficient to capture the probable estimated environmental concentration when limited data are

available.

The models themselves represent a limitation on the analysis quality. These models were not specifically developed to estimate environmental exposure in drinking water so they may have limitations in their ability to estimate drinking water concentrations. Aerial spray drift reaching the pond is assumed to be 5 percent of the application rate. No drift was assumed for broadcast or in-furrow applications. Another limitation is the lack of field data to validate the predicted pesticide run-off. Although, several of the algorithms (volume of run-off water, eroded sediment mass) are validated and understood, the estimates of pesticide transport by PRZM3 has not yet been fully validated. From limited analysis it appears that PRZM3 generates pesticide loadings that are somewhat higher than really occur. This would result in conservative EEC estimates. Other limitations of the models are the inability to handle within site variation (spatial variability), crop growth, and the overly simple soil water balance. Another limitation is that 27 to 40 years of weather data was available for the analysis. Consequently there is a 1 in 27, 36, or 40 chance that the true 10% exceedance EECs are larger than the maximum EEC in the analysis. If the number of years of weather data were increased, it would increase the level of confidence that the estimated value for the 10% exceedance EEC was close to the true value.

EXAMS is primarily limited because it is a steady-state model and cannot accurately characterize the dynamic nature of water flow. A model with dynamic hydrology would more accurately reflect concentration changes due pond overflow and evaporation. Thus, the estimates derived from the current model simulates a pond having no-outlets, flowing water, or turnover. Another major limitation in the current EXAMS simulations is that the aquatic (microbial) degradation pathway was not considered due to lack of data. Direct aquatic photolysis was however included.

Another important limitation of the Tier I and II EECs for drinking water exposure estimates is the use of a single 10 hectare drainage basin with a 1 hectare pond. It is unlikely that this small of a system accurately represents the dynamics in a watershed large enough to support a drinking water utility. It is unlikely that an entire basin, with an adequate size to support a drinking water utility would be planted completely in a single crop or be represented by scenario being modeled. The pesticides would more than likely be applied over several days to weeks rather than on a single day. This would reduce the magnitude of the conservative concentration peaks, but also make them broader, reducing the acute exposure, but perhaps increasing the chronic exposure.

Monitoring data is limited by the lack of correlation between sampling date and the use patterns of the pesticide within the study's drainage basin. Additionally, the sample locations were not associated with actual drinking water intakes for surface water nor were the monitored wells associated with known ground water drinking water sources. Also, due to many different analytical detection limits, no specified detection limits, or extremely high detection limits, a detailed interpretation of the monitoring data is not always possible.

## **Literature Citations**

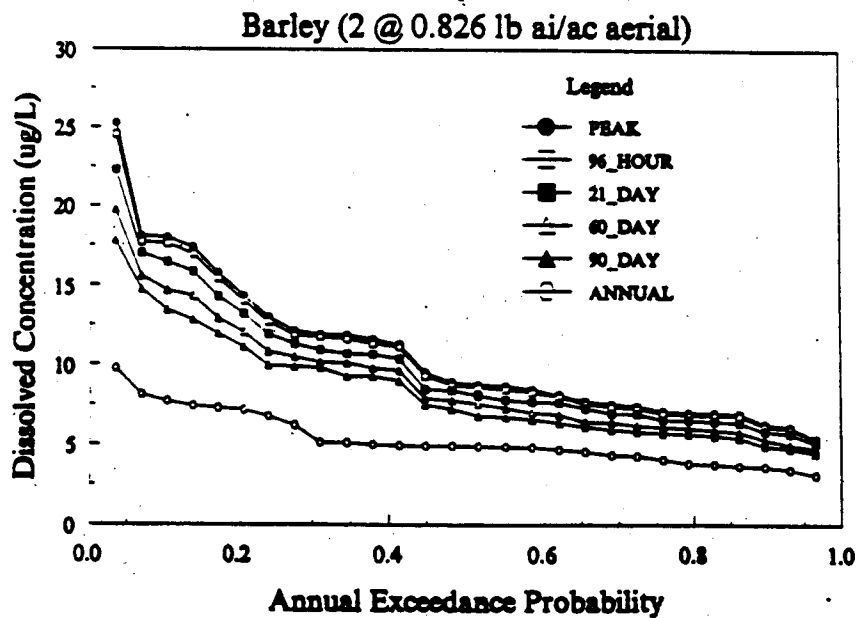
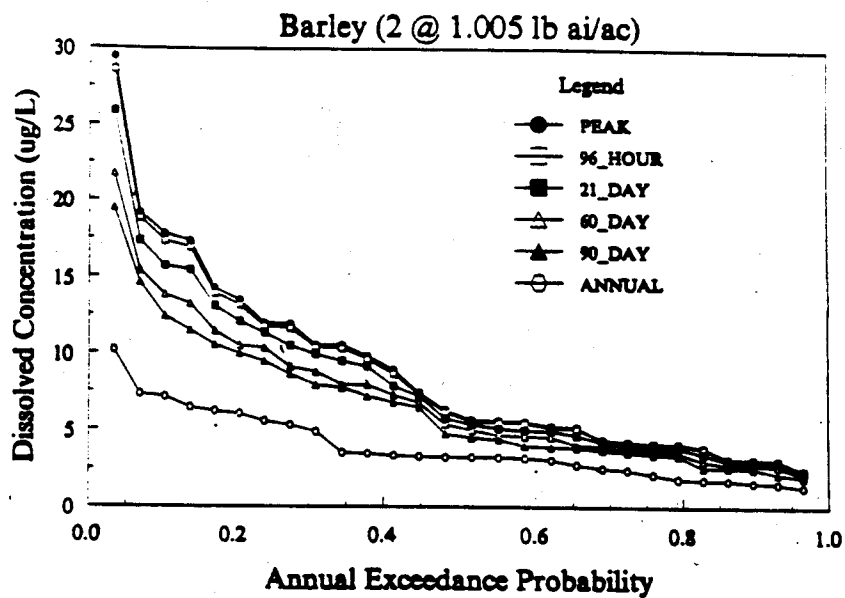
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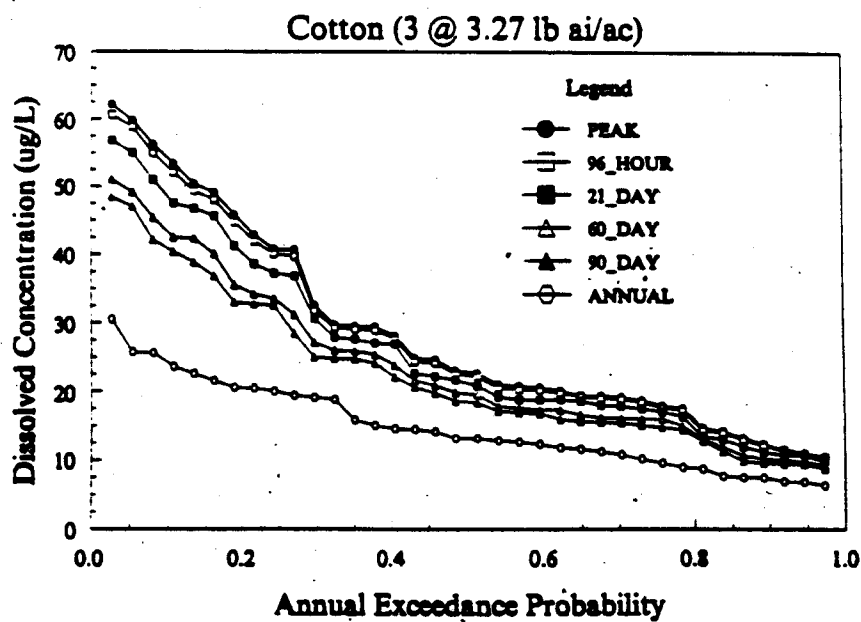
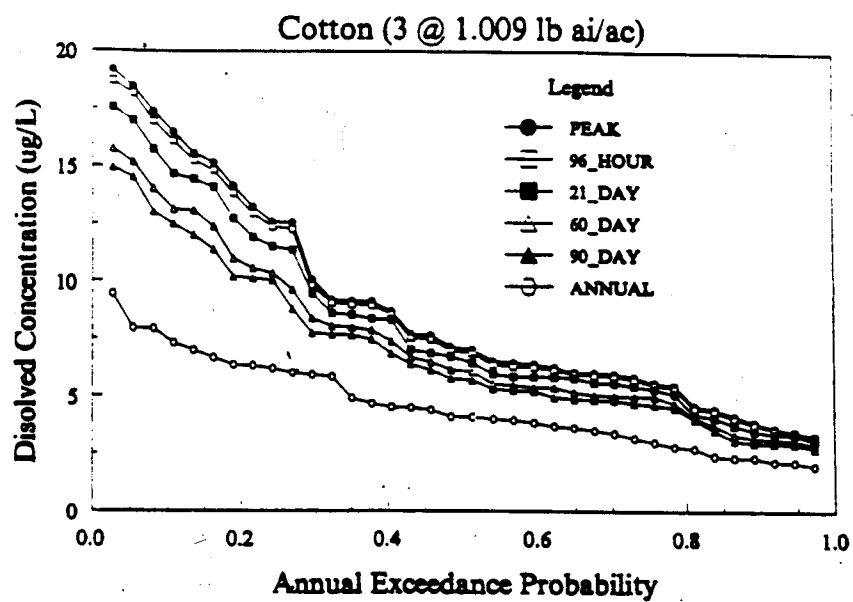
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B. Edwards, RD, 7505C  
D. Locke, HED, 7509C



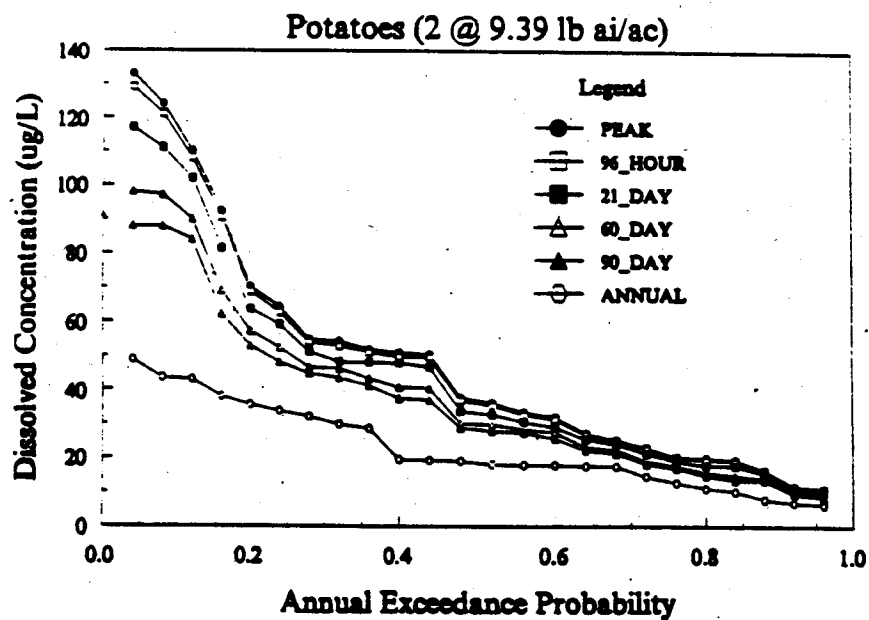
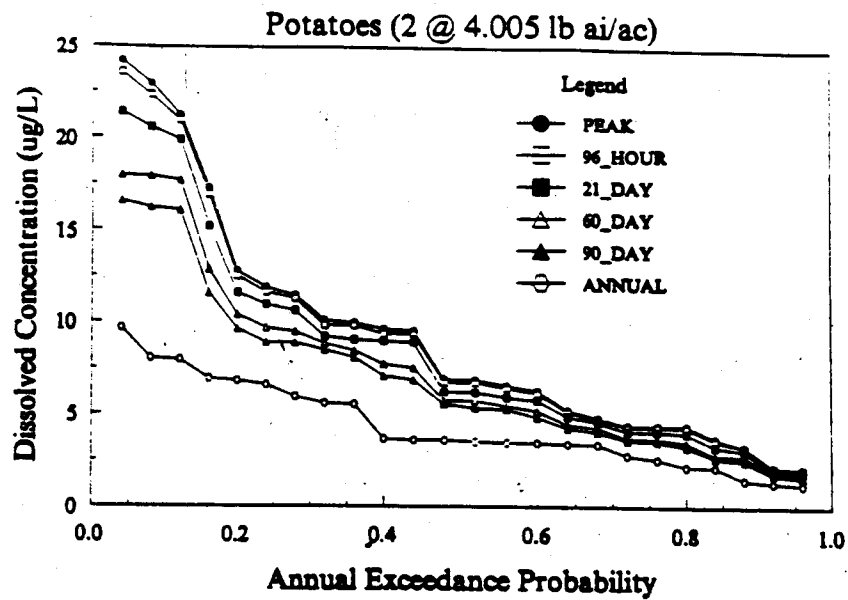
Appendix I. Cumulative frequency plots for disulfoton surface water EECs.



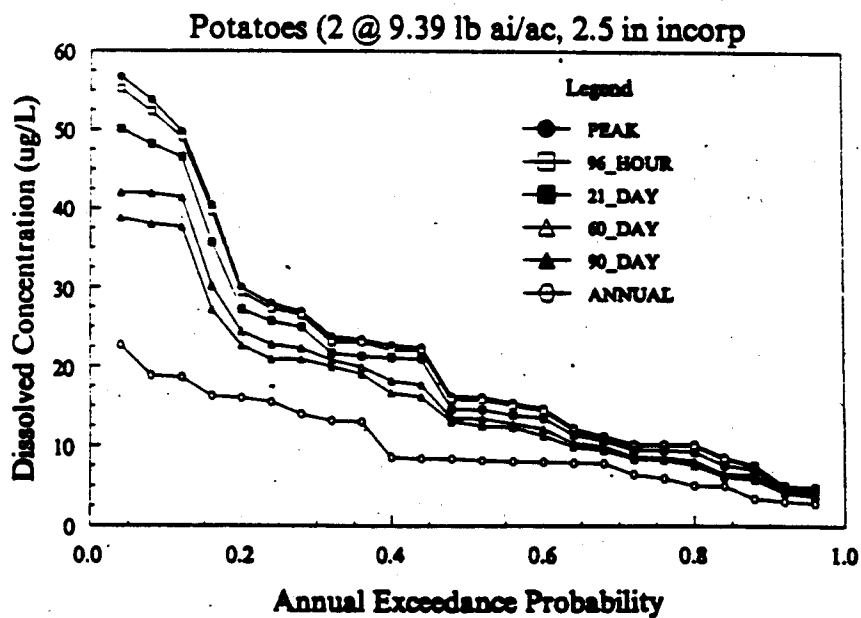
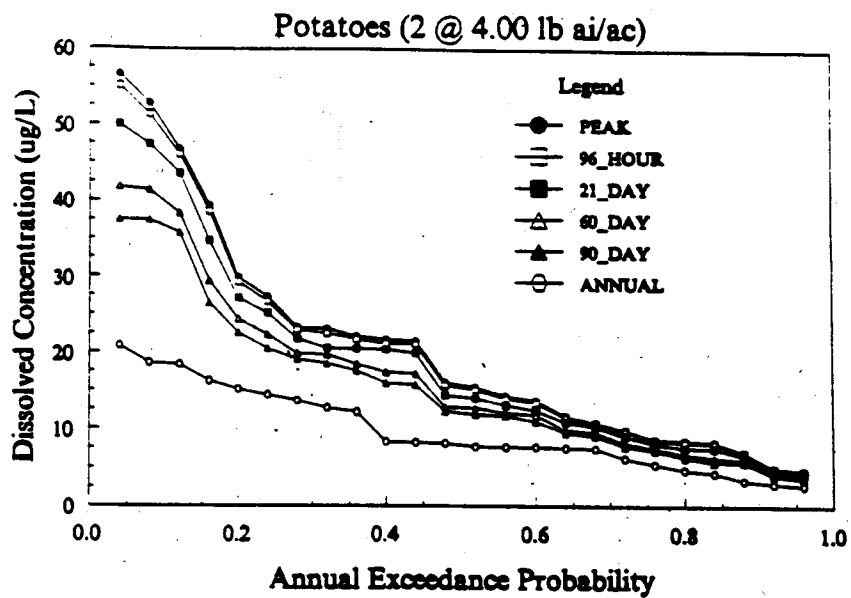
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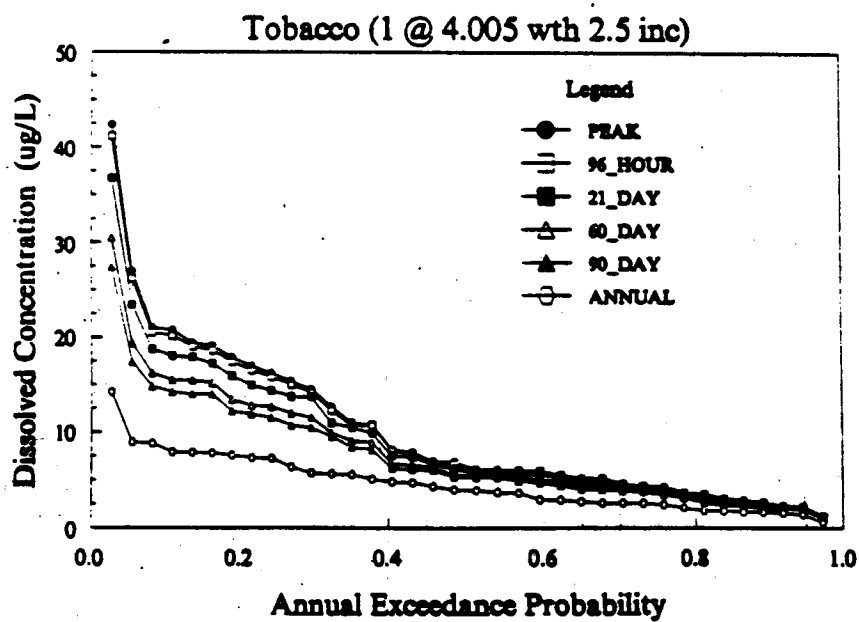
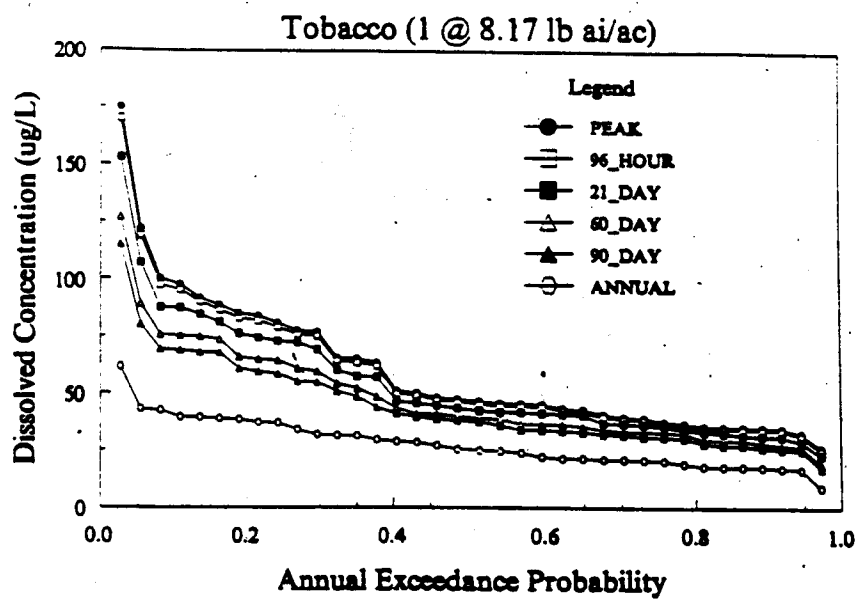


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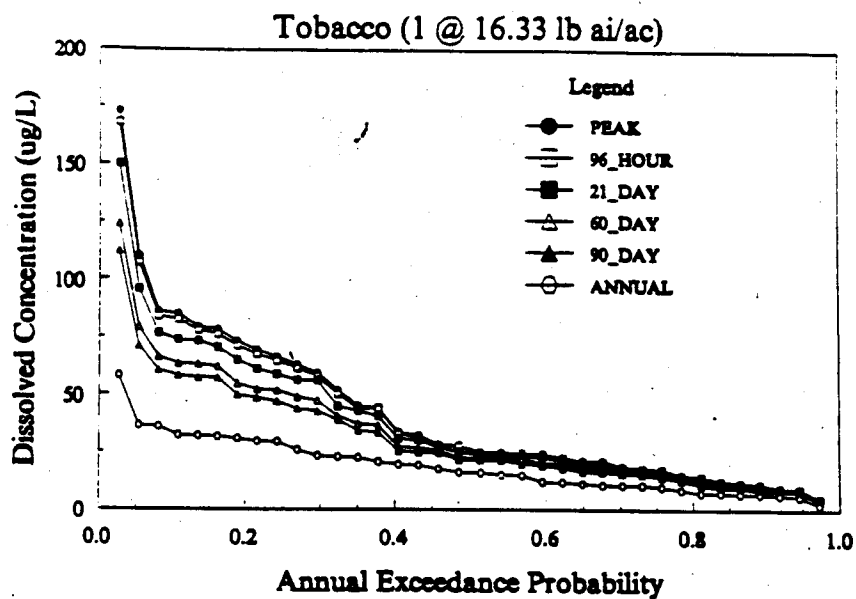


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